

A NEW SPECIES OF TREE SQUIRREL
(*SUNDASCIURUS*) FROM PALAWAN ISLAND,
PHILIPPINES
(MAMMALIA: SCIURIDAE)

Lawrence R. Heaney

Abstract.—A new tree squirrel, *Sundasciurus rabori*, new species, from the mountains of Palawan Island, Republic of the Philippines, is named and described. It is assigned to the subgenus *Aletesciurus* on the basis of cranial characters and morphometrics. Relationships of taxa within the genus are considered briefly.

In 1962, an expedition sponsored by the U.S. Naval Medical Research Unit No. 2, Bernice P. Bishop Museum of Honolulu, and the Silliman University of Dumaguete City, Republic of the Philippines, collected vertebrates on Palawan and nearby smaller islands in the southwestern portion of the Philippines (Kuntz, 1969). Among the 863 mammals obtained, all of which are now deposited at the National Museum of Natural History, Smithsonian Institution (USNM), are five squirrels representing an undescribed species that differs markedly from all other Philippine tree squirrels. This paper describes this new species and briefly documents its relationship to other members of the genus *Sundasciurus*.

Methods

Cranial measurements were made with dial calipers graduated to one-twentieth of a millimeter (mm). All capitalized color names are from Ridgway (1912). All measurements are as defined in DeBlase and Martin (1974) except the following: rostral depth, taken from the point where the maxillary-premaxillary suture crosses the midline on the ventral surface of the rostrum, to the closest point on the midline of the dorsum of the rostrum; rostral length, taken from the anteriormost point of the nasals at the midline to the closest point in the orbit; orbital length, taken from the point in the orbit where the preceding measurement was taken (i.e., the anteriormost) to the most posterior point in the orbit (see Moore, 1959:164); palatal breadth, taken from the labial edges of P4; length of diastema, taken along the midline from the posterior margin of the incisors to the line defined by the anterior points of the maxillary toothrow. External measurements shown in Table 1 were taken from specimen labels. For *S. hippurus* and *S. brookei* the total length shown is the sum of head and body length plus tail length,

as recorded by the collector. A cluster analysis (BMDP2M) and principal components analysis (BMDP4M) were performed on a Honeywell 66-60 computer at the University of Kansas. Comparisons of taxa are based on specimens at the USNM, but data used in compiling Table 1 were also obtained from specimens housed in the Field Museum of Natural History (FMNH), as noted in the text.

Sundasciurus rabori, new species

Holotype.—Adult male represented by skin and skull, USNM 477989. Obtained 16 April 1962 at Magtaguimbong, Mt. Mantalingajan, Palawan Island, Republic of the Philippines, between 3,600 and 4,350 ft elevation by D. S. Rabor; this is approximately 8°48'N, 117°40'E. Skull complete and unbroken; skin well prepared, with terminal portion of tail missing, though the external measurements taken by the collector were probably taken prior to this loss.

Specimens examined.—Skins and skulls of five individuals, all from the type locality, USNM 477985–477989. Numbers 477985 and 477989 are adults; the skull of 477985 is crushed. Numbers 477986–477988 are in adult pelage but had not completed growth, as indicated by thin cranial bone and open basioccipital sutures; I consider these subadults.

Measurements.—External measurements of the holotype, the second adult male, and the mean for the three subadults, all taken from the labels made out by the collector, and my cranial measurements are listed in Table 1.

Diagnosis.—Dorsal and lateral fur dense and soft, mostly 15 mm long, colored a dark brown agouti. Terminal bands black, subterminal bands corresponding most closely to Ochraceous Orange, and basal bands black. Subterminal bands of hair on nose paler than elsewhere, corresponding to Pale Yellow-Orange. Color of the hair on the ears and around the eyes not different from that of the surrounding hair. Ventral region, especially within 1 cm of the midline from the throat to the anal region, and ventral surface of the limbs washed with silver, corresponding to Light Buff. Tail fur agouti with three alternating bands of Ochraceous Orange and black, and tipped with Pale Yellow-Orange. Skull (Fig. 1) relatively gracile; rostrum slender; postorbital region short; temporal ridges not fused to form a sagittal crest; posterior portion of the cranium domed, not curving evenly to the occipital crest; palate narrow, strongly concave. Bullae small, with a single septum which is divided to form a small anteromesial lobe, with no portion conspicuously inflated.

Additional specimens examined.—*S. h. hippurus* (6), Gunong Tebu (350 ft), Trengganu, West Malaysia, USNM 311342–311345, Bukit Besi, Trengganu, West Malaysia, USNM 311346–311347; *S. hoogstraali* (10), 6 km NE San Nicolas, Busuanga Island, USNM 477850–477857, 477860, 477862; *S.*

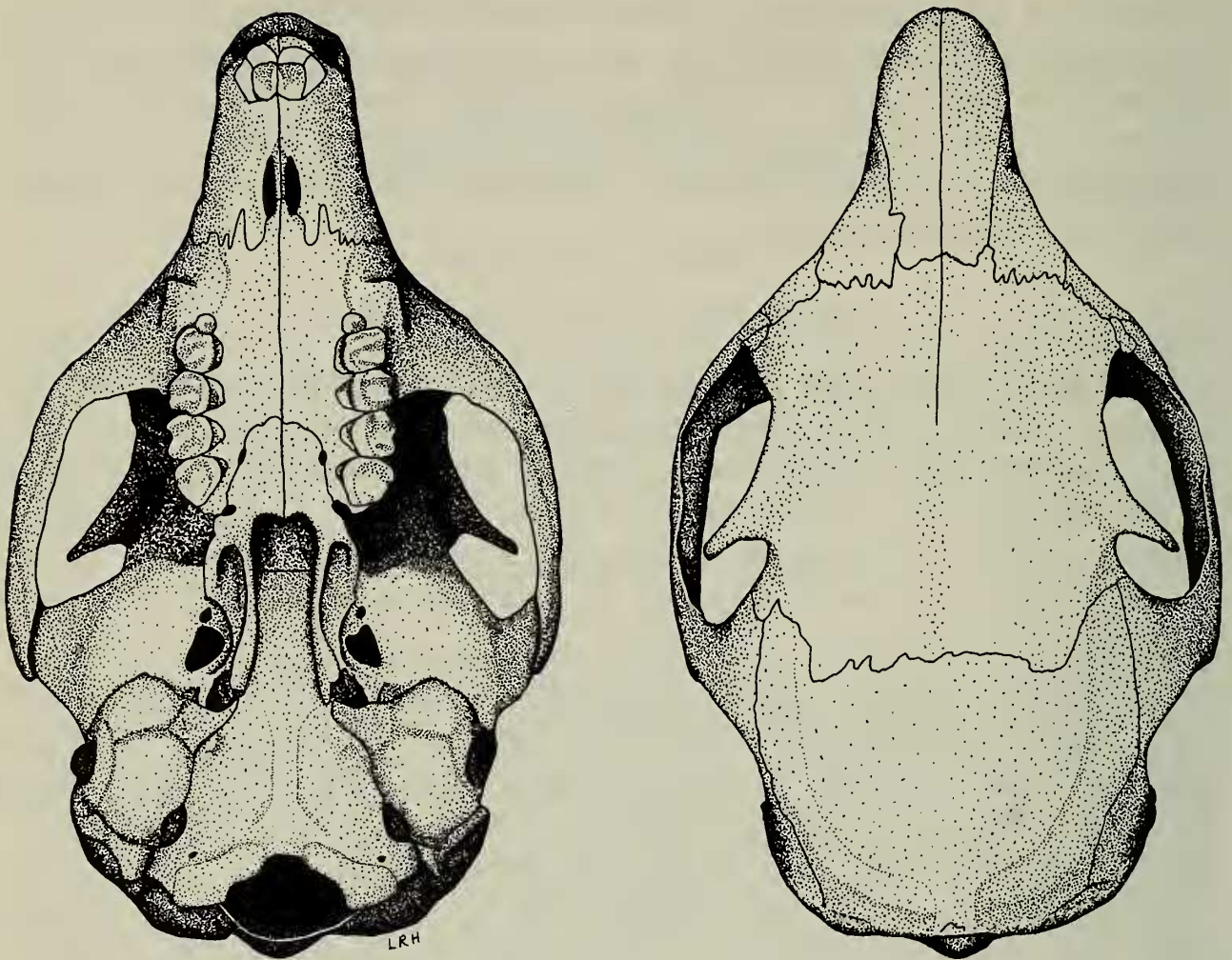


Fig. 1. Ventral and dorsal views of the skull of the holotype (USNM 477989) of *Sundasciurus rabori*, approximately twice life-size.

juvencus (23), Tarabanan, Concepcion, Puerto Princesa, Palawan Island, USNM 477879–477883, 477890–477898, 477902–477910; *S. mindanensis* (2) Loreto, Surigao del Norte, Dinagat Island, USNM 462199–462200; *S. molendorffi* (2), 6.5 km SW Culion, Culion Island, USNM 477946–477947; *S. samarensis* (16), Samar or Leyte Island, USNM 105464–105465; Matugui-
nao, Samar Island, FMNH 87722–87726, Mt. Capoto-an, Samar Island, FMNH 87728–87736; *S. steerii* (21), Minagas Point, Dalawan Bay, Balabac Island, USNM 477964–477984; *S. brookei* (2), Poring, Ranau National Park, Sabah, USNM 488399–488400; *S. j. jentinki* (7), Lumu Lumu, Mt. Kinabalu, Sabah, USNM 292570–292576; *S. l. lowii* (5), Sungei Djambajan, Borneo, USNM 198739, 198744–198745, Ranau, Sabah, USNM 300988–300989, *S. t. tenuis* (10), 16 km N Kuala Lumpur on Pahang Road, Selangor, West Malaysia, USNM 283482–283483, 290160–290167.

Comparisons.—Moore (1958) named the genus *Sundasciurus* on the basis of characters of the bulla, noting that his classification showed some correspondence with that of Thomas (1915) based on the structure of the bac-

Table 1. External and cranial measurements of tree squirrels of the genus *Sundasciurus*. Measurements as defined in the text; all are from adults unless otherwise noted. Standard deviations are given for samples over three.

Taxon	N	Total	Hind foot	Ear	Weight	Con- dylo. orb.	Inter- orb. brdth	Zygo. brdth	Mas- toid brdth	Nasal length	Anter nasal brdth	Ros- tral depth	Ros- tral length	Orbital length	Alve- olar length	max. tooth- row brdth	Pala- tal brdth	Diast. length	Subgenus
<i>S. rabori</i> (type)	1	329	144	43	18	—	43.6	15.9	27.4	19.9	14.9	6.8	9.3	20.2	14.1	9.3	10.0	10.7	
<i>S. rabori</i> (ad. ♂)	1	331	145	44	16.5	—	—	—	—	—	—	—	—	—	—	—	—	—	
<i>S. rabori</i> (subad.)	3	307	133	42	17	—	40.9	14.2	26.5	19.3	13.8	6.0	8.8	18.5	14.3	9.5	9.7	9.9	
<i>S. h. hippurus</i>	6	478.0 ±6.1	245.2 ±4.5	56.7 ±5.9	17.8 ±0.8	422 ±23	54.2 ±0.9	20.0 ±0.5	35.2 ±0.6	23.6 ±0.7	18.5 ±0.5	7.9 ±0.3	12.4 ±0.3	24.0 ±0.3	19.5 ±0.2	9.7 ±0.3	10.6 ±0.3	15.0 ±0.6	<i>Aletesciurus</i>
<i>S. hoogstraali</i>	9	380.8 ±15.3	176.0 ±13.1	45.8 ±2.3	19.3 ±1.6	—	47.2 ±1.8	17.1 ±0.4	30.5 ±0.4	21.7 ±0.6	16.2 ±0.5	7.1 ±0.2	10.2 ±0.2	22.3 ±0.3	16.1 ±0.3	10.7 ±0.3	11.2 ±0.3	12.0 ±0.3	<i>Aletesciurus</i>
<i>S. juvenus</i>	18	368.6 ±11.7	165.3 ±10.0	48.1 ±2.8	17.7 ±1.5	259 ±21	47.1 ±1.0	17.2 ±0.5	29.6 ±0.5	21.6 ±0.4	16.4 ±0.7	7.0 ±0.5	10.2 ±0.3	22.1 ±0.7	15.9 ±0.4	9.6 ±0.3	11.2 ±0.3	11.7 ±0.5	<i>Aletesciurus</i>
<i>S. mindanensis</i>	2	364	161	49	19	—	45.6	17.5	29.9	21.1	15.2	7.2	10.3	20.9	15.4	8.4	10.3	11.9	<i>Aletesciurus</i>
<i>S. mollendorffi</i>	2	399	190	46	20	—	47.5	17.8	31.3	21.9	17.1	7.0	10.1	22.1	15.9	9.9	11.5	11.6	<i>Aletesciurus</i>
<i>S. samarensis</i>	12	353.8 ±7.8	164.7 ±5.2	46.1 ±2.0	18.3 ±0.5	—	45.1 ±0.8	17.0 ±0.5	29.6 ±0.7	21.3 ±0.5	15.5 ±0.6	6.8 ±0.3	10.3 ±0.3	20.6 ±0.6	15.3 ±0.3	8.6 ±0.3	10.5 ±0.3	11.3 ±0.6	<i>Aletesciurus</i>
<i>S. steerii</i>	13	367.9 ±7.7	161.4 ±12.1	43.9 ±2.3	19.6 ±1.1	—	47.6 ±0.9	17.3 ±0.8	30.4 ±0.9	22.0 ±0.6	16.3 ±0.5	7.8 ±0.2	10.6 ±0.3	22.2 ±0.5	15.7 ±0.4	9.9 ±0.4	11.2 ±0.7	12.1 ±0.4	<i>Aletesciurus</i>
<i>S. brookei</i>	2	298	133	36	14	113	37.9	14.7	25.2	18.3	12.7	5.8	8.5	17.4	13.5	7.0	8.9	9.6	<i>Sundasciurus</i>
<i>J. jentinki</i>	5	247.6 ±7.0	116.8 ±9.4	34.2 ±1.5	11.6 ±1.1	—	32.2 ±0.8	12.1 ±0.1	21.6 ±0.5	15.8 ±0.4	10.9 ±0.4	4.9 ±0.3	6.9 ±0.2	14.5 ±0.5	11.8 ±0.3	6.0 ±0.2	7.4 ±0.4	8.2 ±0.6	<i>Sundasciurus</i>
<i>S. l. lowii</i>	5	228.0 ±7.1	87.8 ±11.4	34.6 ±1.5	15.0	—	35.7 ±1.3	11.7 ±0.7	22.9 ±0.6	17.1 ±0.4	11.7 ±0.6	5.2 ±0.3	7.6 ±0.2	15.9 ±0.9	12.5 ±0.5	6.7 ±0.3	8.0 ±0.2	9.5 ±0.5	<i>Sundasciurus</i>
<i>S. t. tenuis</i>	7	250.0 ±12.8	111.3 ±7.1	31.1 ±2.0	13.6 ±1.5	83.0 ±9.6	33.6 ±0.6	12.7 ±0.6	22.6 ±0.5	16.3 ±0.3	11.1 ±0.7	5.2 ±0.4	7.6 ±0.3	15.0 ±0.7	12.1 ±0.4	6.2 ±0.3	8.0 ±0.2	8.6 ±0.4	<i>Sundasciurus</i>

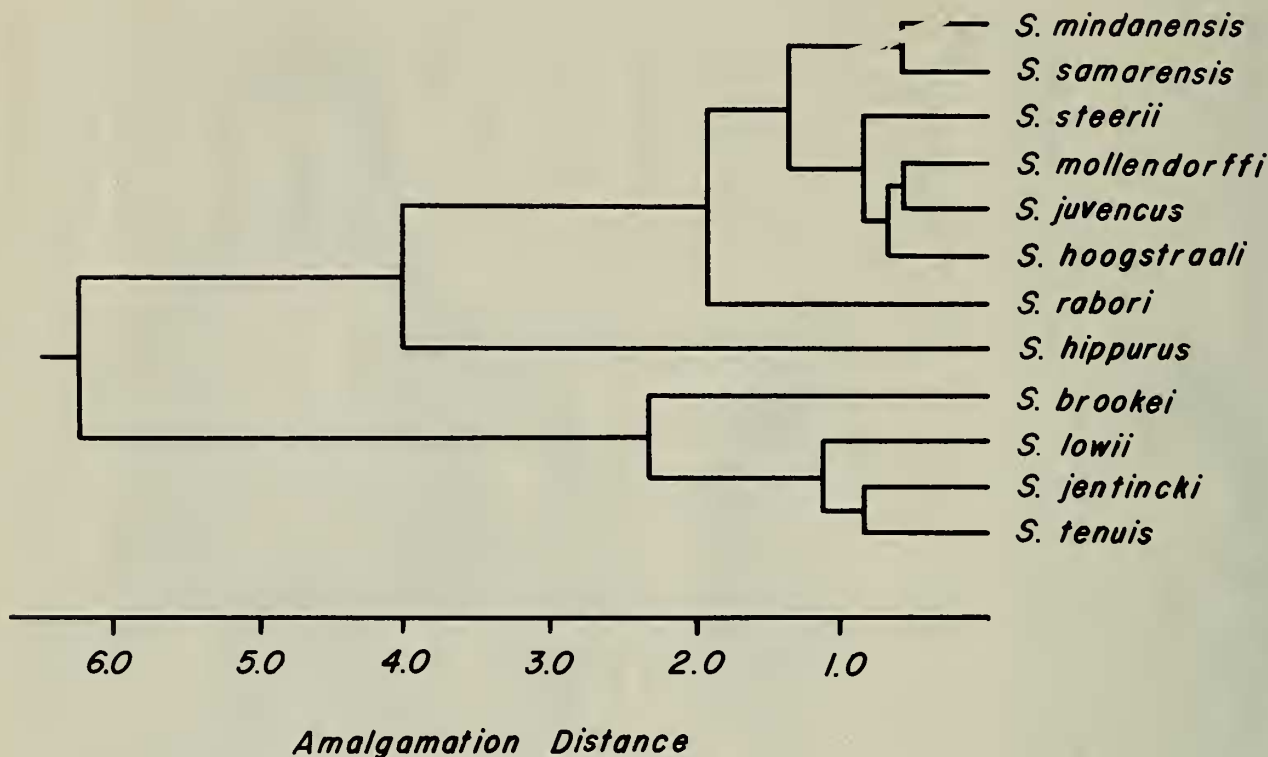


Fig. 2. Cluster phenogram of morphometric similarity of 12 species of *Sundasciurus*, based on data in Table 1.

ulum. He divided the genus into two subgenera. The subgenus *Aletesciurus* included all named Philippine forms, as well as *S. hippurus* from the Sundaic Subregion. Diagnostic features are their larger size (skull length over 50 mm according to the original description, but over 45 mm according to Moore, 1959), presence of an inconspicuous anteromesial lobe in the bulla, and presence of a sagittal crest in adults. The nominate subgenus contained four species, all from the Sundaic Subregion, which have skull lengths under 40 mm, an inflated anteromesial lobe, and no sagittal crest.

Sundasciurus rabori is intermediate in size between the two subgenera as defined by Moore (1958), although closer to *Aletesciurus* (Table 1). In common with the small species, *S. rabori* lacks a sagittal crest; in most sciurids I have examined there is a positive allometric relationship between size and development of the cranial crest, and I hesitate to use the crest as an indicator of relationship without further study. Each bulla of *S. rabori* has a small anteromesial lobe which is inflated more than in *S. hippurus* or the Philippine forms, but is conspicuously less inflated and less sharply defined than in the smaller *Sundasciurus*. Moore (1959) found that the structure of the bulla was a consistent and useful character for discerning relationships among diurnal squirrels. I conclude that, although intermediate in some ways, *S. rabori* is more similar to the subgenus *Aletesciurus* than *Sundasciurus* on the basis of the discrete characters available.

To investigate the relationships of *S. rabori* further, I studied the phenetic

similarity of 12 taxa using a cluster analysis based on the cranial measurements in Table 1, using only the type of *S. rabori* for this analysis. The resulting phenogram (Fig. 2) supports the division of *Sundasciurus* into two subgenera as defined by Moore (1958) and discussed above. Within the subgenus *Aletesciurus* the greatest difference is between *S. hippurus* and the Philippine members of the subgenus. *S. rabori* is most similar to the lowland Philippine squirrels, which are themselves divisible into a southern Philippine group (containing *S. mindanensis* and *samarensis*, and probably *S. philippinensis* and *S. davensis*—not examined), and a Palawan group (containing *S. hoogstraali*, *S. juvencus*, *S. mollendorffi*, and *S. steerii*). It is possible that the southern Philippine group and the Palawan group each represent a species with several subspecies, but further analysis is required before this taxonomic change can be justified, and listing of *S. juvencus* as a subspecies of *S. steerii* by Kuntz (1969) is premature.

I conclude from the above analyses that *S. rabori* is most closely related to the other *Sundasciurus* from the Philippines, and should be assigned to the subgenus *Aletesciurus*.

A principal components analysis identified length of the diastema, orbital length, rostral depth, length of the maxillary molariform toothrow, and palatal breadth as the five measurements most useful for distinguishing among all taxa. *S. rabori* was characterized by this analysis as having a relatively short toothrow, narrow palate, long diastema and orbit, and deep rostrum.

Remarks.—Although specimens of *S. rabori* have been taken only on Mt. Mantalingajan, which is the highest mountain on Palawan at 6,841 ft (2,085 m), they may occur widely on Palawan at elevations above 1,100 m, which is the elevation at which a major vegetational change takes place in most of Southeast Asia (Medway, 1972; Steenis, 1964). Regions above this elevation include substantial areas in the Mantalingajan Range, Victoria Range, and Cleopatra Needle. No other island in the Palawan chain has mountains over 765 m. No information is available regarding the ecology of this species.

Etymology.—This species is named for its collector, Dr. Dioscoro S. Rabor, in recognition of his contributions to knowledge of the vertebrates of the Philippines. I suggest "Palawan montane squirrel" as an English name.

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Museum of Natural History and Department of Systematics and Ecology,
University of Kansas, Lawrence, Kansas 66045.